Name _____Period _____

Statistics

Your Tasks (Mark these off as you go)
☐ Assign group roles
☐ Review precision and accuracy
☐ Complete the pre-lab questions
☐ Explore the precision and accuracy virtual lab
☐ Complete the data collection
☐ Complete the data analysis
☐ Write your own conclusion
☐ Receive credit for this lab

❑ Assign group roles

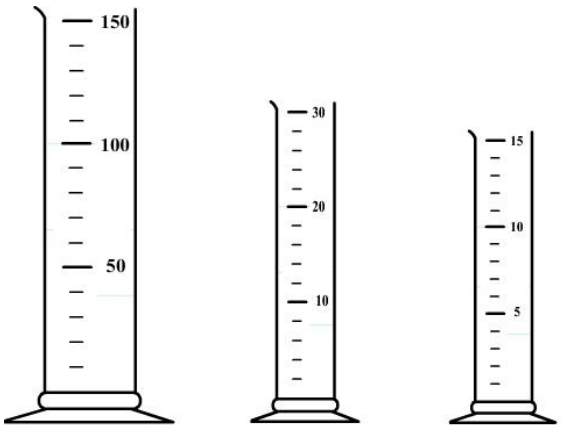
Before you continue, record your group number, then collaborate with your group and assign each person a role. Each role and a description is provided below.

Project manager (PM)	Leads the team discussion and keeps the team on task and on schedule. Make sure the final lab is submitted.
Recorder (R)	Ensures that all members have correct answers.
Communication Specialist (CS)	Presents answers (or questions) to the class, instructor, or other teams.
Strategic Analyst (SA)	Considers how the team is working and ensures all voices are heard

Group Number:	
Name	**Role**

❑ Review Precision and Accuracy

Accuracy is the ability to provide a fine, sharp, clear, valid one time measurement. And, as we have already seen, some instruments are better at providing accurate measurements than others. Consider the graduated cylinders shown below.



Graduated cylinder n°1 The volume between two graduations corresponds to 10 mL

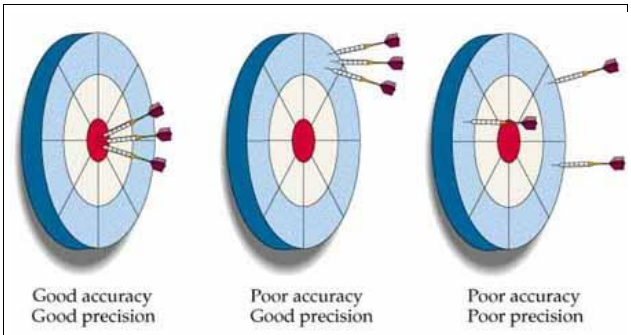
Graduated cylinder n°2 The volume between two graduations corresponds to 2 mL

Graduated cylinder n°3 The volume between two graduations corresponds to 1 mL

Graduated lines improve accuracy. In the illustration, notice that as more lines (graduations) are added, the more accurate the device becomes.

Graduated lines reduce uncertainty. The more graduated lines a measuring device provides, the less uncertain the resulting measurement. A measurement taken with graduated cylinder 1 has an uncertainty of +/-2. A measurement taken with graduated cylinder 2 has an uncertainty of +/-0.2. A measurement taken with graduated cylinder 3 has an uncertainty of +/-0.1

Precision is the ability to obtain the same measurement under the same circumstances repeatedly. To measure precision, multiple measurements therefore must be made. The closer the measurements are to one another, the more precise the measurements. This concept is illustrated below,



Good accuracy
Good precision

Poor accuracy
Good precision

Poor accuracy
Poor precision

The dart hit target (good accuracy). The target was hit repeatedly (goo precision)	The dart did not hit the target (poor accuracy). The darts repeatedly hit the same place (good precision)	The dart did not hit the target (poor accuracy). The darts did not repeatedly hit the same place (poor precision)

❑ Complete the pre-lab questions

Two students ran an experiment to determine the density of an unknown metal. Below are the results. Which student has the most precise data set?
Student A: 2.3 g/mL, 2.5 g/mL, 2.4 g/mL 2.0 g/mL, 2.8 g/mL Student B: 2.1 g/mL, 2.2 g/mL, 2.5 g/mL, 2.6 g/mL, 2.7 g/mL

Which clock is more accurate?


Two students determine the boiling point of ethyl alcohol. The results are shown below. The actual value is 78.37°C. What is the percent error for each student? Which student was most accurate?

Student A	83.0°C
Student B	75.1°C

The data set shown represents student scores on an exam. The standard deviation is 14.2.

Period	Scores	Standard deviation
5	75, 78, 87, 56, 99, 100, 78, 86	14.2
7	66, 72, 82, 56, 76, 96, 78, 90	12.7

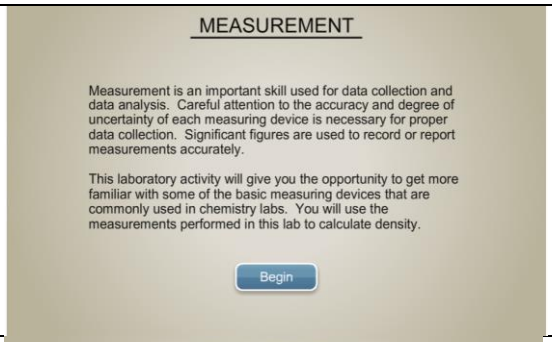
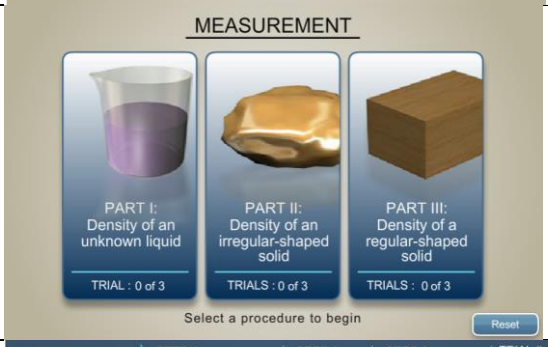
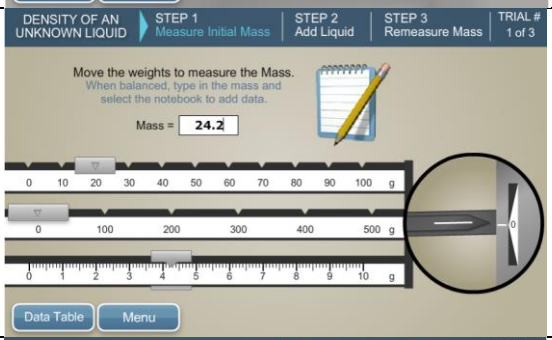
What is the mean (average) for each period?

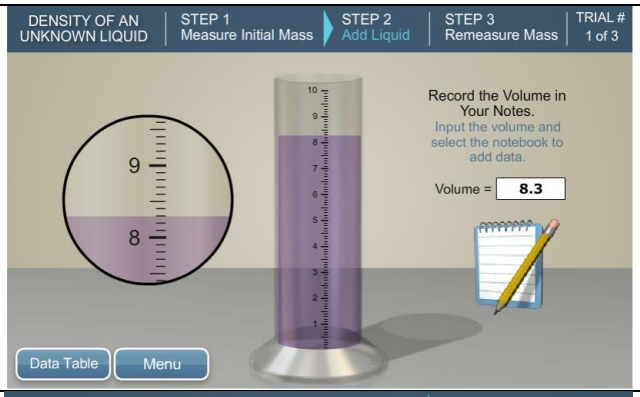
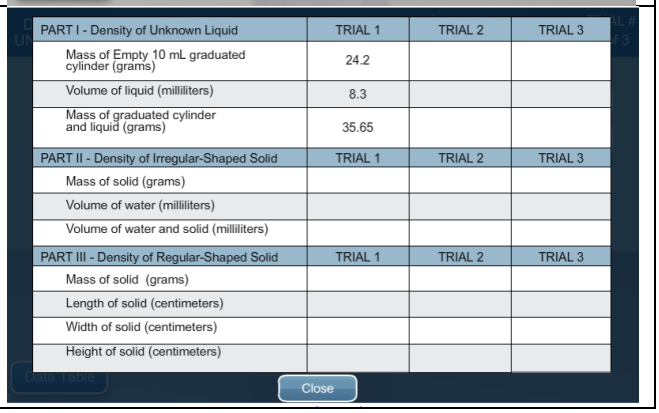
What is the precision for each period?

❑ Explore the precision and accuracy virtual lab

Navigate to precision and accuracy virtual lab. You may need to edit your browser settings to play Flash.

https://moodle.resa.net/images/Chemistry_v10/Number_1/Lessons/01.07_Accuracy_and_Precision/Upload_Folder/01_07c_c.htm

Click the Begin button to get started	
Click on PART 1: Density of an unknown liquid	
To mass an object, click and drag <u>to the balance</u>	
Move the weights to measure the mass. Then type the amount in the box. To record the amount, click on the notebook.	
Drag the liquid to the graduated cylinder to pour the liquid. To stop pouring, click on the graduated cylinder. To resume pouring, click on it again.	

To record the volume, type the amount in the box and click on the notebook.	
Mass the graduated cylinder with the liquid by dragging it to the balance. Move the weights to measure the mass. Then type the amount in the box. To record the amount, click on the notebook.	
Once you have successfully completed one trial, click the New Trial button and repeat the process until you have completed 3. Complete three trials for each Part.	
To view the data for each trial, click the Data Table button. Record the data you collected on this lab guide.	

PART I - Density of Unknown Liquid	TRIAL 1	TRIAL 2	TRIAL 3
Mass of Empty 10 mL graduated cylinder (grams)	24.2		
Volume of liquid (milliliters)	8.3		
Mass of graduated cylinder and liquid (grams)	35.65		
PART II - Density of Irregular-Shaped Solid	**TRIAL 1**	**TRIAL 2**	**TRIAL 3**
Mass of solid (grams)			
Volume of water (milliliters)			
Volume of water and solid (milliliters)			
PART III - Density of Regular-Shaped Solid	**TRIAL 1**	**TRIAL 2**	**TRIAL 3**
Mass of solid (grams)			
Length of solid (centimeters)			
Width of solid (centimeters)			
Height of solid (centimeters)			

❑ Complete the data collection

Complete three trials for each part of the simulator. Have each group member complete one for each part. **Create a table to record your results below**. The table should be well organized and easy to read. All data should include appropriate significant figures and units.

Create your data table here

❑ Complete the data analysis

Precision

For each part of this lab you completed three trials. Calculate the density for each trial. Record your results below,

Results Table			
	Part 1	**Part 2**	**Part 3**
Trial 1			
Trial 2			
Trial 3			
Average	`=average(B2:B4)`	`=average(C2:C4)`	`=average(D2:D4)`
Standard Deviation	`=stdev(B2:B4)`	`=stdev(C2:C4)`	`=stdev(D2:D4)`
Precision			
Accuracy (Percent Error)			

Once you have calculated the densities, copy (Ctrl-c) and paste (Ctrl-v) the data table above into a Google Sheet. If you paste the contents in cell A! the average and standard deviation for each part should calculate automatically.

Use the values for the standard deviation and average, calculate the precision for each part. Record these values in the Results Table above.

$$Precision = \frac{standard\ deviation}{average} x100$$

Accuracy

The accepted values associated for each part of this lab are as follows. Use these values and the average values for each part to calculate the percent error. Record these values in the Results Table above.

Part I accepted value = 1.37 g/mL
Part 2 accepted value = 8.67 g/mL
Part 3 accepted value = 0.637 g/cm^3

$$Percent\ error = \frac{Accepted\ value = Experimental\ value}{Accepted\ value} x100$$

❑ Write your own conclusion

A conclusion is a concise summary of the lab. A conclusion should include the following elements (1) The purpose of the lab, (2) A summary of what you did to accomplish the purpose (3) A summary of your results (4) A summary of errors. For this lab we will only consider the first three parts.

In the space below, use complete sentences to summarize the purpose of this lab.

In the space below, use complete sentences to describe what you did to accomplish the purpose. You could say for example, "In this lab, we used a simulator to determine the density of three unknown substances. For the first unknown we… For the second unknown we.., etc. "

In the space below, use complete sentences to summarize your results. You could say for example, "The first unknown had an average density of 1.41 g/mL, this corresponded to 3% error and 2% precision. The second unknown, etc…". In your summary, you should also indicate for which part you had the best precision and for which part you had the best accuracy.

❑ Receive Credit for this lab

Each group member must complete and submit their own lab to receive credit